Preliminary Engineering Report
Northampton County Southern Node

Northampton County Southern Node Project
Eastern Shore of Virginia Public Service Authority
Northampton County, Virginia

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Construction Administration Program
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Section 1 – Introduction

This Preliminary Engineering Report has been prepared for the Northampton County Board of Supervisors. The report presents the engineering studies and analysis for one of several proposed projects that are intended to provide new sewage collection and treatment facilities on the Eastern Shore.

The area of Virginia collectively known as the Eastern Shore (also called the Accomack-Northampton Planning District) is located on the southern portion of the Delmarva Peninsula. This land region comprises two counties: Northampton, which extends from the southernmost tip of the peninsula to approximately 35 miles north; and Accomack, located directly north of Northampton, extending to the Maryland border.

Virginia's Eastern Shore is an area rich in historical and natural resources, offering a unique quality of life for its residents and visitors. Exploration of these lands began as early as the 1500's and structures from early settlements can still be found in existence today. Many old homes have been restored and are now open to the public. The natural resources on the Eastern Shore are plentiful and rich, with the Chesapeake Bay to the west and the Atlantic Ocean to the east, productive soils, woodlands, a temperate climate, sand dunes, barrier islands, diverse plant and animal life, wetlands, marshes and miles of shoreline. The abundance and quality of the natural resources found on the Eastern Shore provide for an economy built upon agriculture and seafood, and also offer a scenic environment with natural habitats and many recreational opportunities.

One of the most important natural resources is the groundwater supply, which acts as the only source for domestic, agricultural and industrial water use on the Eastern Shore. The groundwater is from a sole source aquifer system that is recharged only by rainfall. The Eastern Shore was designated as a "Ground Water Management /Area" by the Virginia State Water Control Board in 1976 due to some declines in water levels, well interference and instances of contamination. In 1997 the entire Eastern Shore of Virginia was designated a “Sole Source Aquifer System” by the U.S. Environmental Protection Agency. This means that the entire supply of drinking water for this area comes from aquifers that are recharged only by surface waters. One of the major current and potential threats to the groundwater resources is from domestic sewage. Only a very small portion, approximately 15%, of the Eastern Shore is served by public sewer facilities. Most areas are served by septic tanks, while some have cesspools or pit privies. These systems all have a high potential for groundwater contamination. In addition, effluent from septic system pump-outs was until recently disposed of in three unlined, dirt-bermed, anaerobic septage lagoons located in Accomack County. These facilities are a major contamination threat to the precious groundwater resources of the Eastern Shore and have already affected the quality of groundwater, at least in their immediate surroundings. The development of central sewer systems and the provision of adequate treatment of the wastewater in the concentrated growth areas of the County are critical for the health of both the environment and the residents.

In December 1999, the **Eastern Shore of Virginia Public Service Authority (ESVPSA)**

was created by Northampton and Accomack Counties in order to address the water and sewer needs of the area. The goal of the ESVPSA was to protect the precious water resources for the benefit of the residents, visitors, natural environment and the economy.

The first steps in realizing this goal was to include the establishment of central sewer systems in regions defined as growth areas, the development of facilities to handle septage and the abandonment of all unlined septage lagoons. Plans for doing this were well under way in 2004 but, in 2005, the County of Accomack withdrew from the ESVPSA and closed out the remaining studies which had not received support and/or funding to proceed to a construction project. The County of Northampton has retained the ESVPSA but has not yet assigned this authority any projects to pursue. Recently, the Northampton County Board of Supervisors has initiated conversations with the towns to reorganize the ESVPSA structure which has recently been approved in July, 2010. This reorganization includes representatives from four of the towns as well as the county. The County has agreed to serve as the lead entity at this time for this project and anticipates assigning this project to the ESVPSA when the new authority is activated. The ESVPSA currently owns no existing sewage facilities. The only significant treatment and collection facilities on the Eastern Shore have been provided by developers and individual towns with the exception of the mass drainfield system that has been constructed at the Northampton County Complex in Eastville.

Section 2 - Project Planning and Service Areas

Virginia's Eastern Shore is located on the southernmost part of the Delmarva Peninsula. It is bordered to the north by the State of Maryland, to the east by the Atlantic Ocean and to the west and south by the Chesapeake Bay. The specific service area for this project comprises only the County of Northampton which has a land area of 357 square miles and a combined water and land area of 696 square miles.

Project Planning Area

The planning area for the Northampton County Project consists of the entire land area within the County boundary on the Eastern Shore of Virginia. The goal of this project is to provide central sewer facilities to the citizens of the county in the concentrated growth areas. The County has identified one general service area within the project planning area, which is the focus of this report. This area has been identified by the County as a priority for a centralized sewer system, due to current and projected population demands and economic growth. Northampton County is composed of five towns (Exmore, Nassawaddox, Eastville, Cheriton and Cape Charles). The two towns at the northern end of the county are Exmore and Nassawaddox. The two towns at the southern end of the county are Cheriton and Cape Charles. The improvements recommended in around Cape Charles and Cheriton will be referred to as the Southern Project and are the focus of this report. The County as a whole does not provide water or wastewater services to its residents; however, the Towns of Exmore and Cape Charles have taken on this responsibility for some or all of its residents. The Town of Cheriton does not provide any water or wastewater services to its residents but is desirous of bringing such services to the Town. This project will provide the collection system necessary to provide these needed services and the treatment of the wastewater will be provided by the Town of Cape Charles. The proposed service areas and line locations are shown on maps in the Appendix of this report.

Environmental Resources Present

An abundance of historic and natural resources can be found on the Eastern Shore. There are 20 historic sites located in Northampton County. Natural resources include productive soils, forests, open land, dunes, barrier islands, wetlands, the Chesapeake Bay and Atlantic Ocean, beaches, marshlands and surface and groundwater sources. These resources allow for agriculture, timber harvesting and abundant seafood supplies. They also provide diverse habitats for an abundance of plant and animal life, and offer residents and visitors a unique blend of recreational and scenic opportunities.

Northampton County is the southernmost county on the Eastern Shore, extending approximately 35 miles in length with an average width of 6 miles. The environmental resources in this area are vast and plentiful, and have a large influence on the economy and quality of life in the County. There are approximately 50,000 acres of farmland, over 30,000 acres of forestland and around 35,000 acres of tidal wetlands in the region. The County is located completely within the Coastal Plain Physiographic Province, and much of it is within the 100-year flood plain.

There are currently 20 sites within the County listed on the National Register of Historic Places. A preliminary review indicates that no site will be affected by this proposed project. There are no sites of Archaeological significance in the County listed in the Atlas of Virginia Archaeology. The Virginia Department of Natural Heritage listing of Rare and Endangered Squirrel *(Sciurus niger cinereus)* and a vascular plant, Seabeach Amaranth *Amaranthus pumulis),* as extremely rare and critically imperiled.

A review of the available wetlands information indicates that no wetlands will be affected by the proposed project. A field investigation by the US Army Corps of Engineers will be performed to ensure that there are no wetlands located on the proposed disposal sites.

Population Trends and Growth

Between the years of 1930 and 1990, the population of the Eastern Shore of Virginia remained relatively stable. However, between 1990 and 2000, the area experienced a population increase from 44,764 to 51,398, an increase of 14.8%. During this same period the Median Household Income increased by 48% in Accomack County and 56% in Northampton County[1]. Based on the current growth rate the predicted population in 2010 will be nearly 59,000.

The main population centers in Northampton County are the towns of Cape Charles, Cheriton, Eastville, Exmore and Nassawaddox.

One area of concentrated growth on the Eastern Shore is in and around the Town of Cape Charles. This growth has been spurred by the construction of Bay Creek Community that includes a marina and two golf courses.

Northampton County

The population in Northampton County declined slightly in the 1980's and 1990's. However, this trend reversed between 1990 and 2000, although growth has been very gradual and limited (less than 1%). Data from the 2000 Census showed a county population of 13,061.[2] Based on the US Census Bureau estimates, the population is growing at a rate of 0.2% per year. Recent growth rates in and around the Town of Cape Charles suggest that these projections may be exceeded in the coming years especially in some selected areas. Accelerated growth in the project service area will tend to enhance the financial aspects of the project.

Within Northampton County, the service area for this project consists of the Town of Cheriton and areas in the county surrounding Cape Charles. This is referred to as the Southern Project. All of these areas have been identified as development areas, with past, present and predicted concentrated growth.

1 US Census Bureau
2 Chesapeake Bay Bridge - Tunnel Commuter Toll Impact Study, 2001
3 County of Northampton, Virginia Comprehensive Plan Update, 2006

The Town of Cheriton is located approximately 12 miles North of the Chesapeake Bay Bridge Tunnel and was founded in 1889 along with the adjacent Town of Cape Charles. The Town has a total of 1 square mile of land area and a total population of 499. The primary land use is residential with 219 households and 134 families residing in the Town.

Section 3 - Existing Facilities

There are a number of small wastewater systems that exist in Northampton County and have a role in the development of this project. Although they are all listed below, the only one that is involved with this first project is the Cape Charles Treatment Facility which is outlined in item # 1.

1. In Northampton County, the only significant municipal wastewater treatment facility is owned and operated by the Town of Cape Charles. The newly constructed expansion is located on the East side of Town and serves the Town of Cape Charles and the Community of Bay Creek. It is proposed in this project that this facility will be providing sewer service to the Town of Cheriton and some additional areas of the Town of Cape Charles and surrounding areas in the county. This treatment facility is presently being upgraded and construction is expected to be complete in early 2011. The facility will have a capacity of 250,000 gpd and will be capable of expansion to 500,000 gpd and beyond in the future as needed.

2. A private treatment system owned by Shore Health Services, Inc. is located on Hospital Avenue in Nassawaddox. The plant serves Shore Memorial Hospital and several additional customers along Hospital Avenue. The facility is permitted for 100,000 gallons per day and uses extended aeration treatment technology. The plant is at approximately 70% capacity, is 30 years old and does not consistently meet its VPDES discharge limits. The plant's discharge location is an unnamed tributary to Warehouse Creek, which flows to Nassawaddox Creek and out to the Chesapeake Bay. The sludge generated in the treatment process currently has to be hauled to another treatment facility in Maryland due to the recent closing of the septage lagoons in Accomack County. There were never any facilities provided for the treatment, dewatering and disposal of bio-solids at this facility. It is proposed that this facility be taken off line in the future and its wastewater treated in new facilities that will be proposed in another project at a later date.

3. The Town of Exmore has a central sewer system to serve portions of the town. This system uses Grinder Pumps placed in existing septic tanks located in the Central part of Town. The sewage is then conveyed under pressure to a package type treatment facility located on the outskirts of Town and the wastewater is disposed in the ground with the use of several drip irrigation fields located at the plant site. The capacity of the facility is 60,000 gpd and only serves a portion of the Town. The facility was constructed in 2002 and has no facilities for the treatment, dewatering or disposal of the bio-solids that are generated at the facility. The bio-solids are currently being hauled to another facility in Maryland for final treatment and disposal. There is another portion of the Town of Exmore known as the New Road Community where approximately 125 homes are served by septic tanks with disposal of the effluent in a common mass drainfield. The only treatment provided is by the

septic tanks and the facility was constructed in 1999.

4. The Bayview Community in Cheriton has a decentralized wastewater system that was constructed in 2004. The system consists of small holding tanks at the individual dwelling units that retain solids. The liquid portion of the wastewater then flows through a gravity sewage collection system to a common pumping station. The wastewater is then pumped to a wastewater treatment system where the treated effluent is then distributed to a series of drainfields below ground by low pressure dosing. The County is expected to assume ownership and responsibility for operation of the system in the near future. This facility provides service to approximately 120 homes and has a capacity of 31,500 gpd.

   This facility is a stand alone system and will not be a part of this project but will remain in operation.

5. Northampton County owns a small system that provides service to the County Complex. It was constructed in 2008 and consists of a package type treatment facility that discharges to mass drainfield. There are no plans to change the operation of this facility as part of this project.

The majority of residents in Northampton County are without access to centralized sewer systems with treatment facilities and are served by private septic tanks and drainfields. The Virginia law requires that septic tanks be pumped at least once every five years.

Currently, effluent obtained from septic tank pump-outs has to be hauled to a facility in Maryland for treatment and disposal. Until recently, it was disposed of in three unlined, anaerobic, dirt-bermed lagoons in Accomack County. They have recently been closed for further operation but the septage remains in place in each of the lagoons. Two of the septage lagoons were owned and operated by Bundick Well and Pump Company. One lagoon is located near the Town of Atlantic, while the other lagoon is near Mappsburg. The third lagoon was owned by Boggs Water and Sewage and is located near the Town of Wachapreague. These ponds are all located in Accomack County in relatively remote, wooded areas where odor complaints are currently not a large concern. The lagoons are open to the atmosphere and thus their levels are affected by precipitation, which allows for potential overflow events. Records show that the earthen berms surrounding the structures have been breached in the past. This situation allows for the potential contamination of nearby surface waters. The lagoons also pose a constant threat to groundwater quality. With the sandy soils and high water table on the Eastern Shore, these unlined lagoons have a high probability for leaching contaminants into the groundwater supply. Preliminary testing has shown that the lagoons could be a definite source of pollution to the aquifer and the degree and extent of contamination could increase if these facilities are not remediated in the future. The location of the three lagoons is shown in the appendix of this report. Even

though they are located in Accomack County, their location could affect the water supply for Northampton County.

Condition of Existing Facilities

Bayview Community Sewage Treatment

The initial Phase 1 system was completed in December 2003 and has a total capacity of 27,000 gpd. This Phase is approximately 60% built out and has not reached full capacity. A second phase of community development and expansion of the sewage treatment system was constructed in 2004 with a separate treatment system with a capacity of 4,500 gpd. Both facilities are fully operational but both facilities need servicing and removal of solids from the holding tanks located at each dwelling unit as well as at the treatment units.

Nassawaddox Sewage Treatment Plant

This system is owned by Shore Health Services, Inc. and is being operated under VPDES Permit VA0027537. This plant is an extended aeration type facility permitted for 100,000 gallons per day. Current average flows to the facility are approximately 70,000 gpd and
the facility has not been operating satisfactorily for an extended period of time. Some maintenance, including replacement of the in-stream communitor, and structural repairs to the aeration lagoon are required. The facility was never provided with any means for bio-solids treatment, dewatering or disposal and these solids must be hauled to Maryland for treatment and disposal. Consideration should be given to installing bio-solids treatment and dewatering facilities if the plant is to continue in operation.

Exmore Wastewater Facilities

Condition of Existing Facilities

Town of Exmore – Presently the Town of Exmore has two separate and independent treatment and disposal systems in operation.

a. The system that serves a small group of houses on the West side of Town is referred to the New Road Community System. The system was recently constructed in 2002 and includes septic tanks at each of 75 houses with gravity flow to three pumping stations that pump to a mass drain field. There is no further treatment of the septic tank effluent before the application to the drain field which has a design capacity of 50,000 gallons per day. Presently this system is suitable for continued use and the current facilities are adequate. Average Daily wastewater flows from the houses presently connected to this system are 15,000 gallons per day. There have been no reports of any noticeable infiltration or inflow into the system to date. The facility has no means for dealing with the

solids that are generated in the individual septic tanks at each house which needs to be addressed with any expansion on the facilities. It is likely that additional flow capacity could be realized from this facility if the wastewater was given additional treatment prior to the drainfield. The feasibility and cost of using these existing disposal facilities to gain additional capacity for the Town will be investigated as part of this project. The operation of the facilities is in compliance with the existing permit requirements and the Clean Water Act.

The collection and treatment facilities that serve other parts of the Town on the East side of Route 13 were constructed in 2005. This system uses small diameter low pressure sewers for the transmission of wastewater with Septic Tank Effluent Pump (STEP) Units located at each individual connection. The treatment and disposal facilities are located along Seaside Road near the Town Limits. The collection system is in need of service to remove solids from the STEP Tanks and the treatment facility has no means of dealing with any of the waste solids from the treatment process and has to be hauled to MD for disposal. This is a very costly and inefficient method of operation and needs to have a solids treatment, dewatering and disposal process to properly and economically operate the facility. There have been ongoing problems with the operation of the facility due to excessive amounts of infiltration and inflow entering the collection system as well as high pressures due to the lack of suitable air release mechanisms along the transmission lines. The process used for the treatment facility is a sequencing batch reactor (SBR) which is a steel package type plant placed directly on top the ground. Recent problems with controlling the process have required a building to be added around the unit for temperature control of the process. The disposal system uses Drip Irrigation lines adjacent to the treatment facility for disposal of the treated effluent. The existing facilities have a design capacity of 60,000 gallons per day (gpd), with an Average Daily Flow during dry weather of 40,0000 gpd. There are currently 236 connections being served by the system and wet weather flows to the treatment facility often exceed the design rate of 60,000 gpd. The system is currently in compliance with all requirements from the Department of Environmental Quality and the Clean Water Act.

Financial Status of Existing System - Cheriton

Presently the Town of Cheriton has no water or sewer system and this project will be the first project for this area of the County. The Town of Cape Charles will sell services for the treatment and disposal of wastewater to the County under an agreement for service to be completed in the near future.

Section 4 - Need for Project

This project fills a number of significant needs on the Eastern Shore. It addresses concerns for the health and safety of the inhabitants, the environment, and anticipated growth in the service areas.

Health and Safety

The most important issue that this project addresses is the health and safety of residents and visitors on the Eastern Shore. Groundwater is the only drinking water source for the entire area and only a very small portion is treated before use. The sole source aquifer is extremely susceptible to contamination due to the sandy soils and high water table levels where septic systems and abandoned septage lagoons are located along the main recharge spine of the groundwater system. If contamination occurs, it could lead to illness, environmental degradation, the loss of a viable water supply and even the loss of human life. Widespread pollution has not yet been reported in the aquifer and this project seeks to lessen the threat to this valuable water source. The development of the proposed facilities will allow for the abandonment of septic tanks and drainfields in the concentrated growth areas for this project in the County. This project would also eliminate a source of fecal contamination for the nearby Kings Creek which is presently classified by the Department of Environmental Quality as impaired waters with shellfish restrictions.

Current System Deficiencies

The proposed new collection facilities proposed for this project will allow for the abandonment of the virtually all of the existing septic tank systems in the Town, many of which are malfunctioning, and prevent the groundwater contamination from these systems in this growth area of the County.

Growth

Currently, development is hindered by reliance on individual septic systems, which are dependent upon good soils. Such soils are relatively scarce on the Shore and the placement of new septic tanks must be carefully controlled. This project will support growth in the population and the economy in the Cheriton and Cape Charles areas. Growth capacity of 30% over 30 years has been provided in the proposed new facilities, along with provisions for ease of expansion in the future. The design will be based on 400 GPD per ERC and additional capacity will be available based on an expected flow of approximately 150 GPD/ERC. The design number of ERC's for Cheriton and other county areas are 603 ERC’s.

With the central sewer systems proposed for this project, growth and new economic opportunities will be possible in the service areas which include opportunities for residential, commercial and industrial development. The area

has a long history of economic losses and missed opportunities due to its failure to provide sewer service to existing and potential businesses. With the proposed facilities in place, the individual towns can control development and any opportunities that may arise will no longer be missed due to a lack of wastewater services.

Section 5 – Alternatives Considered

Alternatives for the collection, treatment of sewage and disposal of effluent are summarized as follows: Three primary methods of collection were examined for each town's service area. The first was the use of conventional gravity collection systems with pumping stations to convey the waste to the treatment facilities. The second collection alternative was the installation of vacuum collection sewer systems with vacuum sewers and a pumping station to convey the waste to the treatment facility. The third method was the use of grinder pumps and pressure sewers. As part of this project, a new treatment facility and disposal facility was considered as well as the option of using existing capacity in the Town of Cape Charles treatment facility.

Project Alternatives Considered

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Gravity Sewers	Town of Cape Charles	Discharge to the Chesapeake Bay
Vacuum Sewers	Decentralized Treatment Facility near Cheriton	Low Pressure Dosing Drainfield
Low Pressure Sewers		Drip Irrigation

Collection System Alternatives

The alternative to the existing on-site treatment using septic tanks and drain fields is to collect wastewater from each site and convey it to one or more central treatment sites. The collection systems to be considered include gravity systems, vacuum systems, and pressure sewers.

Gravity System

A conventional gravity system would consist of 8-inch collection sewers that would discharge into larger trunk sewers that would convey the wastewater to a pumping station. The pump station would then pump the wastewater through a force main to the treatment site.

Advantages:

1. Simple system with very high reliability and convenience.
2. Sewers can handle grit and solids.
3. Less maintenance required.

Disadvantages:

1. Generally more pumping stations required.
2. Pumping station failure affects entire system.
3. Generally, collection system cannot be extended beyond initial service area when growth occurs.
4. Higher construction costs than other systems.
5. Required manholes are a source of infiltration.

Vacuum System

Vacuum collection uses collector sewers that are maintained under a vacuum, by vacuum pumps. Wastewater flow from the individual service connections is by gravity to a small collection tank. As the level in the collection tank reaches a preset level, the vacuum valve assembly opens and the effluent flows into the collector sewers. Vacuum collector sewers are installed in the same general locations as gravity sewers, but at a shallower bury depth.

A vacuum pump station is required to pull wastewater collected into a vacuum tank, from where it is pumped and conveyed by force main to the treatment site.

Advantages:

1. Wastewater can be conveyed uphill for short distances.
2. Smaller sewer lines (less costly) can be used.
3. Bury depths for vacuum sewers are less than gravity and therefore less costly.
4. No groundwater leakage into system.
5. No manholes required.
6. Fewer pump stations required than for gravity systems.

Disadvantages:

1. Maintenance costs for collection tanks and vacuum valves can be higher than for a gravity system.
2. Pumping station failure affects entire system.

Pressure Sewer System

This collection system requires installing a prepackaged, positive displacement, or other type of pump in a tank to be located near the property line fronting the roadway. The pump will lift the wastewater and convey it to a collection main that will flow to the treatment site. The collection mains will follow the same general route as a gravity system.

Advantages:

1. Wastewater can be conveyed uphill.
2. Smaller sewer piping (less costly) can be used.
3. Bury depths for pressure sewers are less than gravity.
4. Manholes are not required.
5. Reduced infiltration.
6. Use of individual septic tanks reduce treatment requirements since there is less organic loading directed to the treatment facilities.
7. User pays for electricity to operate the pump.

Disadvantages:

1. Maintenance of all individual pumps will be required to be done by the utility.
2. Extended power outages could result in overflows.

The property acquisition requirements for the collection systems in this project will involve obtaining sites for the pumping stations. The number of sites for pumping stations and their respective sizes will depend on the routes that are chosen. Right-of-ways and easements will also be required for the sewer installation and maintenance. All of the necessary property will need to be acquired by the County for construction of the proposed facilities. The estimated property acquisition costs are included in the estimated costs of the pump stations and related facilities.

Because of the nature of the subsurface conditions on the Eastern Shore, a number of concerns exist that will affect construction and operation costs of the proposed facilities. One issue of special concern is the high water table in this area. Sandy soils and running sand conditions are also a concern. These issues will be especially significant if a gravity system is chosen as the method of conveyance, due to the considerable depths and the excessive costs associated with construction of such systems.

Treatment Alternatives

1. Obtain Service from the Town of Cape Charles

This option involves pumping the wastewater to the newly expanded and upgraded treatment facility owned by the Town of Cape Charles. The current flow to the facility from Cape Charles is approximately 150,000 gpd, which leaves a significant amount of unused capacity available for serving the area in and around the Town of Cheriton. The existing rated capacity of the facility is 250,000 gpd however many of the individual units are sized for future flows. The facility is also readily expandable to 500,000 gpd and beyond with minimal construction cost so that capacity would be available for both Cape Charles and Cheriton in the future. This would be a more regional approach to the problems of providing wastewater treatment for the area as it centralizes the operation and maintenance operations from both areas.

Advantages:

- The existing system has already been funded and constructed.
- Would eliminate any additional personnel requirements for operation and maintenance duties if both systems were combined as proposed

Disadvantages:

- Wastewater requires a higher level of treatment compared to a decentralized system with in ground disposal.

2. Decentralized Treatment Facility near Cheriton

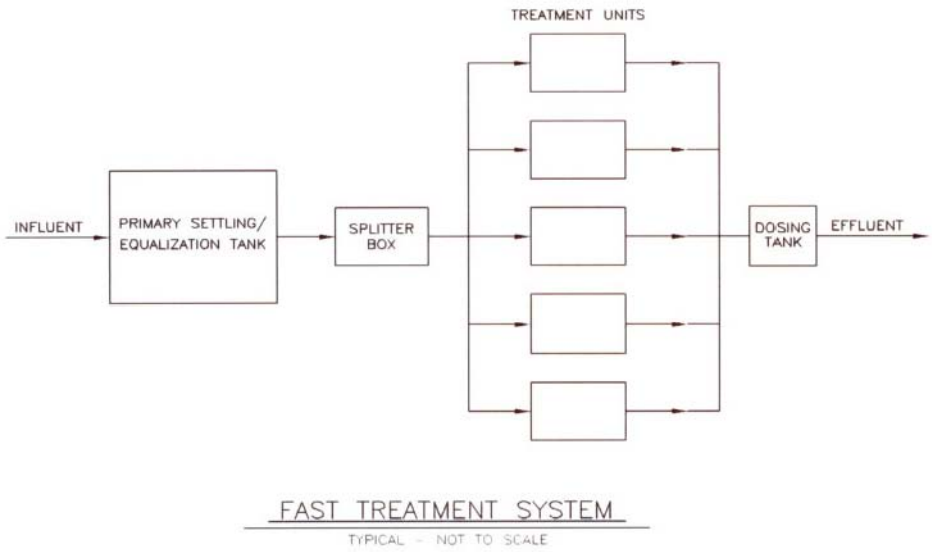
Options

- **Packed Bed Filter Systems - FAST by Bio-Microbics**: A Fixed Activated Sludge Treatment (FAST) wastewater treatment system is a pre-engineered modular apparatus designed to treat wastewater from small communities. FAST is a fixed film, aerated system utilizing a combination of attached and suspended growth, capable of nitrification and denitrification in a single tank This combination includes the stability of fixed film media and the effectiveness of proven activated sludge treatment, making the FAST system very reliable.

  A FAST system provides an ideal home for large volumes of friendly organisms in the inner aerated media chamber to digest the wastewater and turn it into a clear, odorless, high-quality effluent. The attached growth system assures that more organisms remain inside the system instead of being flushed out, even during times of peak hydraulic flows. During times of low usage, the large volumes of thriving organisms prevent a dying-off of the system, making FAST equally well suited to intermittent use applications.

  Proper conditions are present to allow nitrification and denitrification to occur in the same tank without any system modifications. Special patented technology

allows FAST to consistently reduce nitrogen levels-including nitrates and all other nitrogen species by an average of 70%.



Advantages:

1. Generally it is the most economical system of this type based on capital and installation costs.

2. Lowest operating and maintenance costs.

3. Suitable for construction in areas of high water table.

Disadvantages:

1. Requires periodic removal and disposal of settled and sloughed materials from the tanks

- **Packed Bed Filter Systems - Bioclere, by Aqua Point:** In the Bioclere plant the biofilter is enclosed and insulated. Hydraulic dosing and sludge return pumps are set at predetermined rates. Oxygen is introduced to the system through a blower in the housing and is exhausted through a vent that is usually located in the effluent pipe. Dosing pumps located in this baffled chamber distribute the wastewater over the filter media. In the trickling filter, a population of microorganisms that attach to the filter media and form a biological slime layer reduces the organic material in the wastewater. In the outer portion of the slime layer, aerobic microorganisms accomplish treatment. As the microorganisms multiply, the biological film thickens and diffused oxygen and organic substrate are consumed before penetrating the full depth of the slime layer. Consequently, the biological film develops aerobic, anoxic, and anaerobic zones.

The microorganisms in the anaerobic zone near the media surface periodically lose their ability to cling to the media due to the lack of sufficient oxygen and food. The wastewater flowing over the media washes the slime layer from the media bed and a new slime layer begins to form. This process of losing the slime layer is called "sloughing" and is primarily a function of the organic and hydraulic loading on the filter. This natural process allows the media bed to be self-purging and maintenance-free. The sloughed biomass settles to the bottom of the sump as sludge. These secondary sludges are periodically pumped back to the primary tank for storage, and eventually removed.

Nitrification is accomplished by cultivating a healthy microorganism population and an environment where pH, temperature, organic loading, and supply of oxygen are stable. In a Bioclere system, the pH is buffered by the carbonate system associated with the wastewater; the temperature remains constant because of the insulated environment and the exothermic biological activity.

Denitrification utilizing septic tank carbon is widely considered to be the most economical and efficient method for nitrogen removal. Utilizing prescribed recirculation rates, nitrified wastewater is returned to the anoxic zone of the primary tank where influent wastewater provides a suitable carbon source for the denitrification reaction. In this process, bacteria convert the nitrate to nitrogen gas, which is then released to the atmosphere.

The Bioclere's fixed film process and hydraulic capacity minimize the impact of organic and hydraulic fluctuations on the treatment process and effluent quality. Generally, installations do not require flow equalization prior to treatment.

Advantages:

1. Sloughed sludge is returned to the primary tank.

Disadvantages:

1. Difficulty and high expense of constructing foundations in high water table area.
2. A large primary tank is required for settling and recirculation.
3. Requires addition of a coagulant.
4. Requires periodic removal and Disposal of sludge.

- **Packed Bed Filter Systems - AdvanTex:** The influent enters the recirculation-

blend tank, where it blends with the contents of the tank. A septic tank effluent pump in the recirculation-blend tank transports the blended effluent to an automatic distribution valve, then to a distribution manifold in the filter pod. The biofilter pod contains a manufactured textile medium contained in watertight tanks. The influent is distributed to the individual tanks through a dosing system and is sprayed above the textile tilter medium. Air is introduced with a fan and exhausted through an installed vent. The system operates in a similar manner to the other Packed Bed Filter Systems.

After passing through the filter media, the treated effluent passes out of the filter pod to the recirculation valve. The valve automatically splits or diverts the flow between the recirculation-blend tank and the final discharge; the valve also controls the liquid level in the tank. During extended periods of low flow into the system, 100% of the treated effluent is returned to the tank.

Advantages:

1. Timer controlled pump in recirculation tank doses filter system in a controlled manner.

Disadvantages:

1. Needs a costly 40,000-gallon (minimum) recirculation blend tank.
2. Higher installation and capital costs.
3. Higher shipping cost from west coast manufacturer.

Discussion:

The FAST System is recommended for this location due to the ease and lower cost of construction in the areas of high water table and sandy soils. Based on this, detail costs for comparison were only performed on this option for comparison.

Disposal System Alternatives

1. **Discharge to Chesapeake Bay**: This option is only applicable if the decision is made to direct the raw sewage from Cheriton and vicinity to the existing Town of Cape Charles Treatment Facility. This facility is presently permitted to discharge into the Chesapeake Bay and is well under capacity.

   Advantages:

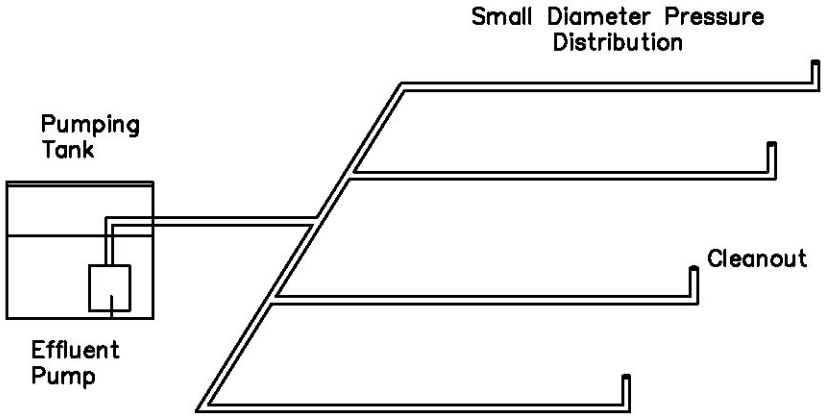
   1. Requires no land purchases for disposal system

2. Does not require any operation or maintenance time for disposal of effluent.

Disadvantages:

1. Requires a higher degree of treatment as compared to land disposal.

2. **Low Pressure Drainfield:** A low pressure drainfield system is a shallow, pressure dosed soil absorption system with a network of small diameter perforated pipes placed 10- to 18-inches deep in 12- to 18-inch wide trenches. A pump moves the effluent from the treatment system to the manifold to the distribution laterals in the trenches under a low pressure (3 to 5 feet of head). The laterals are PVC pipes with small holes, placed in narrow gravel filled trenches.



Low Pressure Drainfield System

Advantages:

1. Distribution through pressurized laterals disburses the effluent uniformly throughout the entire drainfield area.

2. Less land area required for the absorption system than gravity flow drainfield.

3. Shallow placement of trenches promotes evapotranspiration and promotes growth of aerobic bacteria.

4. Periodic dosing and resting cycles enhance aerobic conditions in the soil.

Disadvantages:

1. Limited storage capacity around laterals.

2. Monitoring and maintenance of the system is required.

3. **Drip Irrigation:** Drip irrigation distribution is a method of pressure distribution capable of delivering small precise volumes of wastewater effluent to the infiltration surface. The system consists of a pump, a distribution unit, supply manifolds, dripline and emitters, and vacuum release valves. The dripline is normally a ½ inch diameter flexible tube with emitters spaced 1 to 2 feet along its length.

   Advantages:

   1. Less site disruption during construction.
   2. Can be adapted to irregular shaped areas.

   Disadvantages:

   1. Requires regular operation and maintenance.
   2. More costly to construct than other systems.
   3. Requires filtering effluent and constant maintenance.

Section 6 – Selection of an Alternative(s)

Design Criteria

In order to consider treatment and disposal requirements for this project, it was first necessary to estimate the quantity of wastewater expected to require treatment in the service area proposed. The number of residential units, schools and commercial facilities was determined for the service area proposed. The residential units (ERC) were estimated to be two bedroom units, on average, allowing for the occupancy of four residents per unit. Based on the Virginia Department of Health Sewage Collection and Treatment Regulations, 100 gallons per day (gpd) per person should be used as a design basis in computing sewage flow estimates for new sewage works. Schools were estimated to have an average of 500 students with an estimated flow of 16 gpd per student. Within the service area there is a wide variety of commercial establishments with varying demands for wastewater treatment. An estimated average flow of 600 gpd has been used for each commercial user for this study if no more specific information was available.

The estimated volume requirements of wastewater treatment for the proposed service area estimated in the following table:

Cheriton and Surrounding County Area

Description	ERC Quantity	Flow (gpd)	Estimated Flow (gpd)
Residential	615	400	246,000
Commercial	92	600	55,200
Total			301,200

This represents the maximum probable flow from the existing service area if 100% of all existing customers elected to connect to the system.

System design capacities and ultimate capacities are provided in the following table:

Cheriton and County Service Area:

Proposed Ultimate Capacity

Design Capacity Required @ 400 gpd/ERC	301,200	gpd
20 year growth at 30%	90,360	gpd
Ultimate Capacity Required @ 400 gpd	391,560	gpd

This represents the design ultimate capacity of the collection system.

Design for 80% Residential signups @400 gpd/ERC

80% of Residential Connections = 492 ERC	196,800	gpd
80% of Commercial Connections = 111 ERC	44,400	gpd
Total =	241,200	gpd

Anticipated Actual Flow@ 150 gpd/ERC

80% of Residential Connections = 492 ERC	73,800	gpd
80% of Commercial Connections = 111 ERC	16,650	gpd
Total =	90,450	gpd

This represents the probable average daily flow of wastewater from the initial service area.

The Cheriton treatment system will be initially designed to accommodate a wastewater flow of 90,450 gpd and will be expandable to an ultimate capacity of 391,560 gpd. The ultimate design capacity of the collection system is based on a flow of 400 gpd per equivalent residential connection (ERC). The anticipated actual initial wastewater flow with 80% residential and 80% commercial connections to the system is 90,450 gpd. If the option of pumping the wastewater to the Town of Cape Charles for treatment and disposal is selected, there would need to be additional capacity added to the Town's plant in the future to handle the future volume of wastewater from this area..

Service Area Map

A map indicating the proposed layout of the wastewater system in the service area is included in the Appendix of this report. The map details the location of pumping stations, treatment and disposal facilities and proposed routing of the vacuum lines for the collection system. Both alternatives for treatment and disposal are shown for clarity.

Land Requirements

Approximately 0.5 acres of land will need to be acquired by the County for a pumping station and 50 acres for a treatment and disposal facility if the Decentralized Treatment Option is selected.

Project Costs

The summary of estimated probable construction costs, operating expenses, and the present worth of construction costs plus 20 years of operating expenses for each of the alternatives considered are indicated in the following table.

Construction Costs

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Gravity $11,758,570	FAST $2,106,000 Packed Bed Filter	Discharge to Chesapeake Bay $ 0
Vacuum $6,816,115	Pump to Town of Cape Charles Treatment Facility $ 1,084,752	Low Pressure $340,000
Low Pressure $7,428,332		Drip $602,000

Note: The highlighted cells indicate the selected alternatives.

Annual Operating Expenses

Collection Alternatives	Treatment Alternatives	Disposal Alternatives
Gravity $151,000	FAST $94,000 Packed Bed Filter	Discharge to Chesapeake Bay $0
Vacuum $88,100	Pump to Town of Cape Charles Treatment Facility $ 176,000	Low Pressure $5,000
Low Pressure $186,000		Drip $54,000

Note: The highlighted cells indicate the selected alternatives.

Detailed estimates of capital and operating expenses are included in the Appendix of this report.

Present Worth of Construction & Operating Expenses

The present worth was determined for a 20 year period of annual operating expenses that are increasing at 2% per year. The interest rate used was 4.875% in accordance with RUS Instruction 1780.

From the capital and operating costs data above, the two lowest cost options were compared by performing a present worth analysis to give a more in depth comparison of the alternatives.

Alternative 1 was a Vacuum Collection System with a force main to transmit the wastewater to the existing Cape Charles Wastewater Treatment Facility.

Alternative 2 was a Vacuum Collection System with a Decentralized Treatment Facility using a packed bed system known as a FAST process followed by a disposal system using Low Pressure Dosing.

The analysis started with the initial capital costs and then calculated the present worth value of the corresponding operation and maintenance costs for each option and added it to the capital cost. The remaining salvage value of each alternative was added to the present worth costs to give a final number that more accurately compares the two alternatives. As can be seen from the summary of results above, the present worth analysis clearly shows that Alternative 1 is the less expensive alternative by $421,000.

This analysis represents one method for the comparison of alternatives. There are other factors that should be considered when evaluating options of this magnitude that may not be apparent in a simple comparison of numbers alone. One of these factors is the overall goal of the County to create a regional system that will minimize duplication of efforts and manpower to provide the most cost effective facilities for providing treatment and disposal of wastewater for the entire county. This principle involves the plans minimizing the number of future facilities as growth requires expansion of these services.

Present Worth Summary

Alternative 1	**Alternative 2**
Present Worth	Present Worth
$11,181,711	$11,602,696

The detailed calculations for the Present Worth Analysis are included in the Appendix.

Section 7 – Proposed Project

The proposed project will provide wastewater collection and treatment services within the Eastern Shore Town of Cheriton and surrounding areas in Northampton County. The system will be capable of being extended North and South along Route 13 as desired in the future or outside of the Town as growth in the area requires.

The proposed collection system selected will be a vacuum system which will consist of a series of 4, 6 and 8 inch pipes that will convey the waste water to a single vacuum station. From this point the wastewater will be pumped to the treatment plant site**.**

The treatment method selected for the proposed alternative is to utilize the additional capacity in the new Cape Charles Treatment Facility which has already been designed to handle the wastewater from this project. Both of these options are the most cost effective methods to handle the wastewater needs from this area as illustrated in the previous section of this report.

The disposal of the treated wastewater effluent will be a discharge to the Cape Charles Harbor which has already been permitted and approved.

An additional treatment system for trucked in septage will be located at the Exmore site in the future which is not part of this project. A cost summary of the proposed project is included in this section of the report. Detailed estimates of probable construction costs are contained in the Appendix.

Advantages/Disadvantages

Since this is the initial major sewage collection and treatment system that is being constructed by the County on the Eastern Shore, it was necessary to provide a system that was not only the least capital cost but the most reliable and least cost system to operate over the long term. Since the cost of wastewater treatment is a major factor in the affordability of these services, it was also necessary to eliminate leakage into the system from surface water to minimize treatment costs. The County has limited resources for operational personnel and it was imperative to also minimize the amount of operator attention for all of the facilities involved. The selected alternative is compatible with existing comprehensive plans for the service areas involved and satisfies public and environmental concerns. The collection system recommended will eliminate extraneous groundwater due to infiltration as it is essentially a closed system and operated off of vacuum. It will consist of one pumping station with a backup power supply, which will provide a very high degree of reliability. The treatment alternative selected, of delivering the wastewater to the new Cape Charles Treatment Facility, will utilize the manpower and cost of the existing staff employed by the Town and minimize costs by regionalizing and sharing the costs for the provision of these services.

Project Design

Treatment

Treatment will be provided by utilizing the excess capacity in the Cape Charles Wastewater treatment Facility. Services for this will be contracted for from the Town of Cape Charles in the near future. Negotiations have been started and both parties are agreeable to the plan proposed.

Pumping Stations

The single pumping station required for this project is shown on the project layout maps in previous sections of this report. The pumping station will be a combination vacuum and pumping station and will include a generator as a separate source of power for backup in the event of a power outage to satisfy reliability requirements for this project.

Collection System Layout

The layout of the proposed vacuum collection system is shown on maps in the Appendix. The detailed line lengths have been included in the detailed cost estimates in the Appendix of this report. They include the line sizes as well as accessories required for the system. The key advantage of the vacuum collection system is that it can be easily and cost effectively constructed in an area such as the Eastern Shore that has a high water table and relatively porous soils and has the advantage of extending the system without the need for additional pumping stations. It also has the advantage of the elimination of the surface water intrusion into the system as often occurs on gravity type systems, which can severely reduce the capacity of the treatment and disposal system for expansion in the future.

Estimate of Probable Construction Cost

The probable construction cost of the selected alternative is:

Vacuum Collection System	$6,816,000
Pumping Station and Generator	$790,000
Force Main to Cape Charles Facility	$1,005,000
Incidental Costs	$2,210,000
Land Costs	$100,000
Total Project Cost	**$10,921,000**

Detailed cost estimates are included in the Appendix.

Rate Schedule

The following Rate Schedule was used in developing the initial annual operating budget and the seven year cost projection:

Connection Charge	$1,000
Availability Charge (Residential)	$2,500/connection
Availability Charge (Commercial)	$3,500/connection
Service Charge	$62/mo./ERC

Estimated Annual Operating Expenses

The seven year cash flow analysis is shown in the Appendix, which indicates that the project is financially feasible based on the requirements stated and the assumptions noted.

Proposed Yearly Operating Budget

Eastern Shore of Virginia Public Service Authority

Operating Revenues

Existing and New Residential Service Charges @$62.00/mo/ERC	$ 368,280
Existing and New Commercial Service Charges@$62.00/mo/ERC	$ 89,520
New Inspection and Account Fee @$200	$ 800
Total Operating Revenues	**$ 458,600**

Operating Expenses

Total Operation and Maintenance costs for Collection System	$ 88,100
Total costs for Treatment and Disposal at Cape Charles	$ 176,000
Debt Service Payment for new facilities	$185,653
Total Operating Expenses	**$449,753**

Net Income or Loss **$ 8,847**

Funding Sources

DEQ – VRLF (requesting)	$ 10,920,746
Rural Development	$ 0
DHCD	$ 0
Total	**$ 10,920,746**

Section 8 - Conclusions and Recommendations

1. Based upon the estimated construction costs of the various options available to the County at this time, we have concluded from the summary of costs indicated in the previous section, that utilizing a vacuum collection system, is the most feasible and cost effective method of wastewater collection. Our analysis of the expected income or loss from the first year of operation is shown in the previous section and further supports this conclusion, assuming that the initial rates for all customers begin at a minimum of $62.00 per month for each residential equivalent connection. Our analysis shows that the operational losses for the gravity system are significantly higher than for the vacuum system due to the higher costs of construction and operation. From this it can be concluded that the monthly minimum rates to support a gravity wastewater collection system would be significantly higher than the $62.00 per month proposed with the vacuum system and would not be acceptable.

2. The feasibility of this project is very sensitive to the number of initial connections on the systems in the early stages of development of the project. This study is based on the assumption that 80%, of the residential and 80% of the commercial properties will sign up. Significant efforts will be required in order to secure the service agreements and connections. Modifications will need to be made to the financial program as changes take place.

3. We have performed an initial cash flow projection over a twenty-year period of operation on a preliminary basis to assess the long-term viability of this project. We have determined the amount of debt that would have to be incurred by the County using certain assumptions. For the purposes of this initial analysis, we have assumed that the project receives forgivable loans from the Department of Environmental Quality in the amount of at least 50% of the project cost or $5,460,373. Based upon those figures and an assumed interest rate of 0% percent on loans or bonds that would have to be issued on this project for the funds remaining, we have concluded that an initial minimum monthly charge of $62.00 per equivalent residential connection and a connection charge of $1,000 per single family residential equivalent will be required for future connections after construction is completed. In addition, an availability charge of $2,500 will be required to be paid by all new residents locating within the service areas of the project in the future. Based upon these assumptions, we have concluded that a positive cash flow will begin in the first year of operation and increase with growth to a positive cash balance of approximately $250,931 in the fifth year. This is assuming an increase in rates of 3% per year for the future.

4. It is apparent that additional interim financing will be required for the first three years of operation in order to achieve the desired coverage ratio of 115% for servicing of the loans for this project. The associated charges for this have been included in the estimated costs for this project.

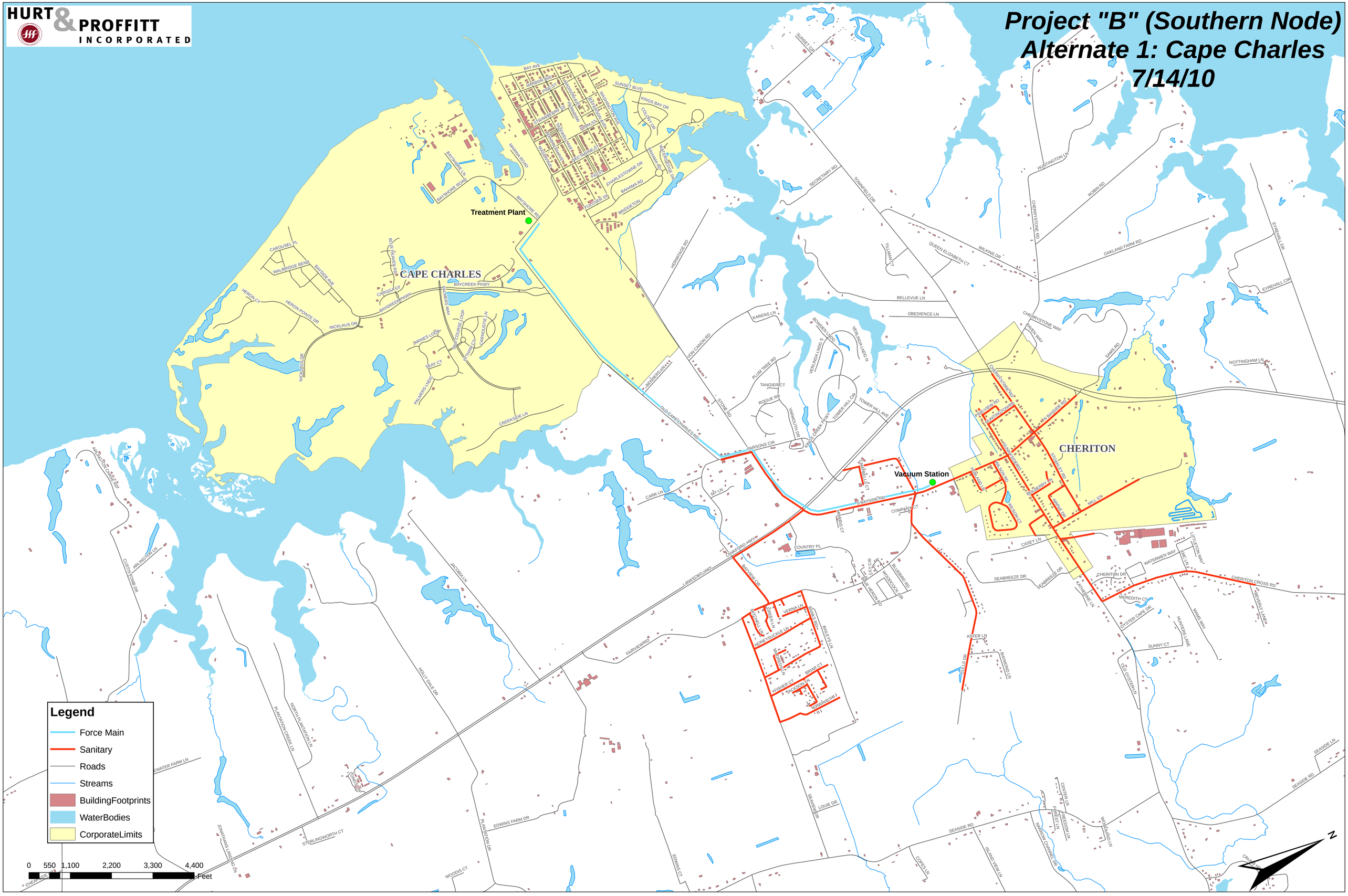
5. The median household income (MHI) for Northampton County in 2008 was $34,424. This is 56% of the MHI for Virginia as a whole, which is $61,210. This demonstrates a very limited ability for the residents in this area to afford central waste treatment systems. Guidelines from other federal agencies would indicate that the affordable rate per month for the local MHI would be $43. Financial analysis of the project cost indicates the need for a significant amount of grant money and low interest loans for this project to become affordable for the residents in the area. Therefore, additional funding should be sought by the County from other agencies to assist in reducing project costs and reduce the rates to an affordable level for the residents.

Appendix A

Project Alternative Maps

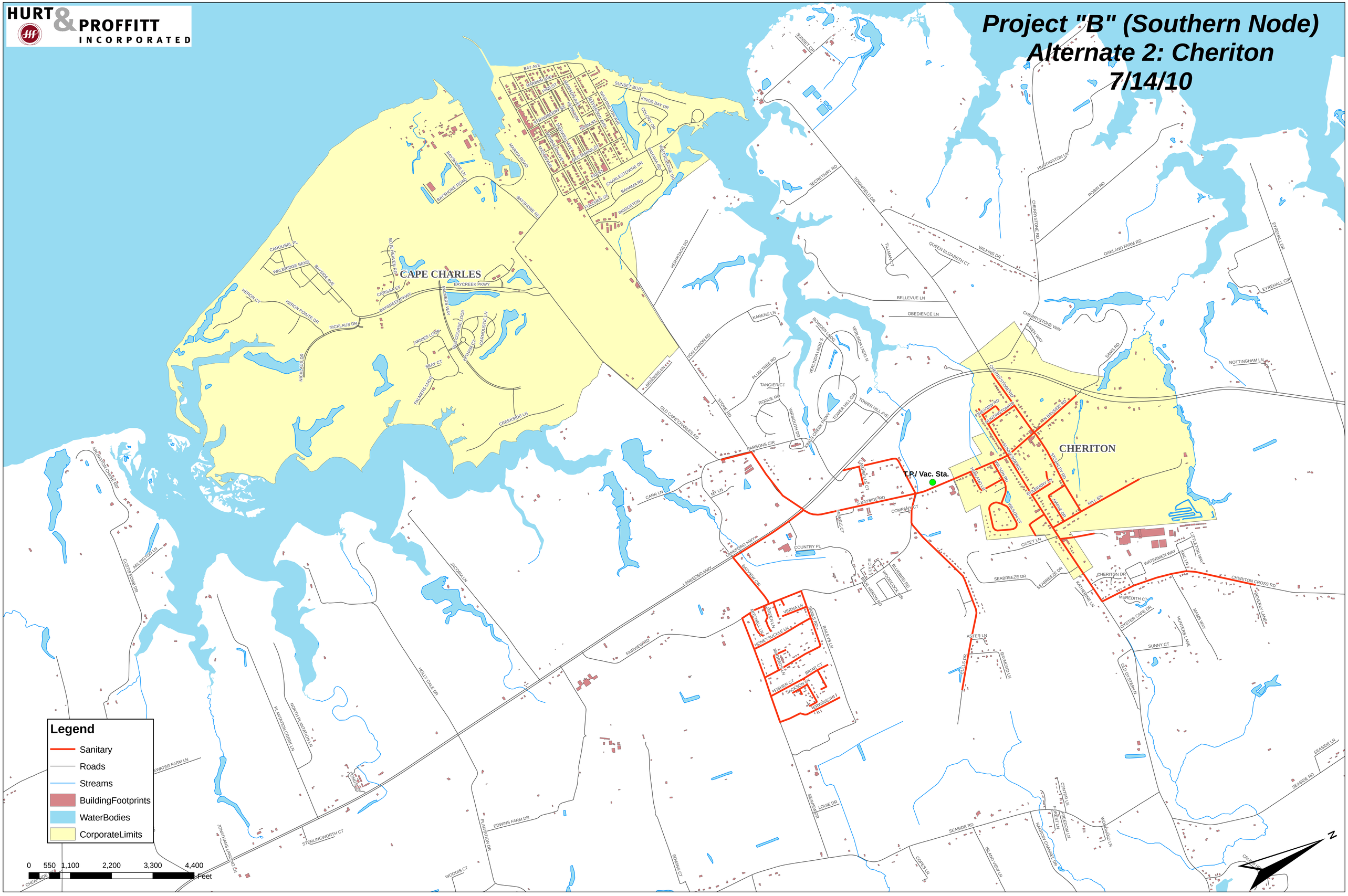
HURT & PROFFITT INCORPORATED

Project "B" (Southern Node)
Alternate 1: Cape Charles
7/14/10



HURT & PROFFITT INCORPORATED

Project "B" (Southern Node)
Alternate 2: Cheriton
7/14/10



Appendix B

Opinion of Probable Construction Cost:
- Collection Systems
- Treatment Systems
- Disposal Systems

Northampton County
Opinion of Probable Construction Costs: Collection Systems

Gravity				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
8-inch Gravity Sewer	72,150	LF	$65	$4,689,750
Force Main	13,960	LF	$60	$837,600
Pump Stations	12	EA	$450,000	$5,400,000
Cleanouts	566	EA	$220	$124,520
Service Connection	566	EA	$700	$396,200
Manhole Frame & Cover	270	EA	$600	$162,000
Manholes	270	EA	$550	$148,500
Gravity Total				$11,758,570

Vacuum				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
10" Vacuum Main	620	LF	$40	$24,800
8" Vacuum Main	3,345	LF	$35	$117,075
6" Vacuum Main	18,147	LF	$30	$544,410
4" Vacuum Main	51,385	LF	$26	$1,336,010
3" Service Lateral	320	EA	$1,000	$319,600
10" Isolation Valve	1	EA	$1,500	$1,500
8" Isolation Valve	2	EA	$1,250	$2,500
6" Isolation Valve	14	EA	$1,000	$14,000
4" Isolation Valve	27	EA	$800	$21,600
AIRVAC Valve Pit Package	320	EA	$4,100	$1,310,360
Special Tools	1	Set	$5,300	$5,300
Spare Parts	1	Set	$5,960	$5,960
Trailer Mounted Vacuum Pump	1	EA	$35,000	$35,000
Installed Vacuum Station	1	EA	$790,000	$790,000
Road Bores	1,000	LF	$250	$250,000
Railroad Bores	250	LF	$300	$75,000
Pavement Repairs	10,000	LF	$35	$350,000
Vac Station Site Preparation	1	LS	$50,000	$50,000
Maintenance of Traffic	1	LS	$30,000	$30,000
House Connection (Same Side)	246	LS	$1,500	$369,000
House Connection (Opp. Side)	246	LS	$3,000	$738,000
Business Connection (Same Side)	37	LS	$2,500	$92,000
Business Connection (Opp. Side)	37	LS	$5,000	$184,000
Field Service Technician (Airvac) - full-time	1	LS	$150,000	$150,000
Vacuum Total				$6,816,115

Pressure				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Provide & Install STEP Unit	566	EA	$5,000	$2,830,000
4" PVC Installed (SFR Connection)	37,850	LF	$17	$643,450
3" PVC Main Installed	22,702	LF	$22	$499,444
4" PVC Main Installed	30,626	LF	$29	$888,154
6" PVC Main Installed	11,803	LF	$34	$401,302
8" PVC Main Installed	8,154	LF	$40	$326,160
10" PVC Main Installed	8,814	LF	$48	$423,072
4" Wye	566	EA	$96	$54,336
4" Bends & Fittings	73	EA	$83	$6,059
6" Bends & Fittings	34	EA	$89	$3,026
8" Bends & Fittings	12	EA	$95	$1,140
10" Bends & Fittings	9	EA	$101	$909
Automatic Air Release Valves	4	EA	$1,400	$5,600
Isolation Valves	14	EA	$700	$9,800
Monitoring Wells	5	EA	$1,000	$5,000
Roadway Crossings	560	LF	$40	$22,400
Maintenance of Traffic	1	LS	$30,000	$30,000
House Connection (Same Side)	246	LS	$1,500	$369,000
House Connection (Opp. Side)	246	LS	$3,000	$738,000
Business Connection (Same Side)	37	LS	$1,500	$55,200
Business Connection (Opp. Side)	37	LS	$3,000	$110,400
Asphalt Road Repairs	168	SY	$35	$5,880
Pressure Total				$7,428,332

Northampton County
Opinion of Probable Construction Costs: Waste Water Disposal Systems

Low Pressure Drainfield				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Clearing & Grubbing	1	LS	$5,000	$5,000
Erosion & Sediment Control	1	LS	$5,000	$5,000
Drainfields	1	EA	$280,000	$280,000
Dosing Tanks	1	EA	$50,000	$50,000
Total				$340,000

Drip				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Clearing & Grubbing	1	LS	$5,000	$5,000
Erosion & Sediment Control	1	LS	$5,000	$5,000
Pump	1	EA	$12,000	$12,000
Supply Lines	1	LS	$40,000	$40,000
Tubing	220000	LF	$2	$440,000
Electrical	1	LS	$100,000	$100,000
Total				$602,000

Northampton County
Opinion of Probable Construction Costs: Treatment Systems

FAST by Bio-Microbics				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Treatment Plant	1	LS	$1,000,000	$1,000,000
Treatment Plant Property	50	AC	$15,000	$750,000
Treatment Plant Site Preparation	1	LS	$200,000	$200,000
Mobilization	1	LS	3.00%	$58,500
Permits, Bonds, Fees	1	LS	5.00%	$97,500
Treatment System Cost				$2,106,000

Cape Charles Treatment System				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
12" Force Main	16,740	LF	$60	$1,004,400
Mobilization	1	LS	3.00%	$30,132
Permits, Bonds, Fees	1	LS	5.00%	$50,220
Treatment System Cost				$1,084,752

Appendix C

Opinion of Probable Operations & Maintenance Cost:
- Collection Systems
- Treatment Systems
- Disposal Systems

Northampton County
Opinion of Probable Operations & Maintenance Costs: Collection Systems

Gravity System				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Pump Station Repair & Replacement Cost	1	LS	$36,000	$36,000
Pump Station Annual Power Consumption	12	EA	$5,000	$60,000
Line Maintenance	1	LS	$5,000	$5,000
System Labor	1	LS	$50,000	$50,000
Gravity System O&M Cost				$151,000

Vacuum System				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Repair & Replacement Cost	1	LS	$12,800	$12,800
Annual Power Consumption	1	LS	$25,300	$25,300
System Labor	1	LS	$50,000	$50,000
Vacuum System O&M Cost				$88,100

Pressure System				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Grinder Pump Repair & Replacement Cost	1	LS	$113,000	$113,000
STEP Tank Pumping	1	LS	$23,000	$23,000
System Labor	1	LS	$50,000	$50,000
Pressure System O&M Cost				$186,000

Northampton County
Opinion of Operations & Maintenance Costs: Treatment Systems

Decentrailzed (FAST)				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Repair & Replacement Cost	1	LS	$5,000	$5,000
Annual Power Consumption	1	LS	$63,000	$63,000
Testing	1	LS	$3,000	$3,000
Telemetry	1	LS	$1,000	$1,000
Administration & Billing	1	LS	$10,000	$10,000
System Labor	1	LS	$12,000	$12,000
Decentralized (FAST) System O&M Cost				$94,000

Cape Charles Treatment				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Cape Charles WWTP O&M (County share)	1	LS	$ 89,600	$89,600
Cape Charles WWTP Debt (County share)	1	LS	$ 86,400	$86,400
Cape Charles System O&M Cost				$176,000

Northampton County
Opinion of Probable Operations & Maintenance Costs: Disposal Systems

Low Pressure Drainfield				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Drainfield Mowing	1	LS	$2,000	$2,000
Drain line cleaning	1	LS	$3,000	$3,000
Low Pressure Drainfield O&M Cost				$5,000

Drip				
Description	**Quantity**	**Unit**	**Unit Price**	**Probable Cost**
Drainfield Mowing	1	LS	$4,000	$4,000
Labor for filter cleaning & maintenance	1	LS	$ 50,000	$50,000
Drip O&M Cost				$54,000

Appendix D

Present Worth Analysis

Present Worth Analysis

Community Name: Northampton County - Southern Node

Federal Discount Rate for Water Resources Planning (Interest Rate) i = 0.04875

Number of Years, n = 20 years

Alternate 1:

Initial Capital Costs =	$7,901,000
Annual Operations & Maintenance Costs =	$264,000
Future Salvage Value =	$115,200
Present Worth of 20 years of O & M =	$3,325,175

PW = **Annual OM *(1+i)^n-1 / i*(1+i)^n**

Present Worth of 20 yr Salvage Value =	$44,464

PW = **FSV* 1 / (1 + i)^n**

Alternative 2 Total Present Worth =	$11,181,711

Alternate 2:

Initial Capital Costs =	$9,262,000
Annual Operations & Maintenance Costs =	$187,000
Future Salvage Value =	$37,920
Present Worth of 20 years of O & M =	$2,355,332

PW = **Annual OM *(1+i)^n-1 / i*(1+i)^n**

Present Worth of 20 yr Salvage Value =	$14,636

PW = **FSV* 1 / (1 + i)^n**

Alternate 1 Total Present Worth =	$11,602,696

Appendix E

Opinion of Probable Cost for Selected Alternative : Alternative 1 – Cape Charles

Northampton County
Opinion of Probable Costs for Selected Alternatives: Alternative 1 - Cape Charles

Description	Quantity	Unit	Unit Price	Probable Cost
10" Vacuum Main	620	LF	$40	$24,800
8" Vacuum Main	3,345	LF	$35	$117,075
6" Vacuum Main	18,147	LF	$30	$544,410
4" Vacuum Main	51,385	LF	$26	$1,336,010
3" Service Lateral	320	EA	$1,000	$319,600
10" Isolation Valve	1	EA	$1,500	$1,500
8" Isolation Valve	2	EA	$1,250	$2,500
6" Isolation Valve	14	EA	$1,000	$14,000
4" Isolation Valve	27	EA	$800	$21,600
AIRVAC Valve Pit Package	320	EA	$4,100	$1,310,360
Special Tools	1	Set	$5,300	$5,300
Spare Parts	1	Set	$5,960	$5,960
Trailer Mounted Vacuum Pump	1	EA	$35,000	$35,000
Installed Vacuum Station	1	EA	$790,000	$790,000
Road Bores	1,000	LF	$250	$250,000
Railroad Bores	250	LF	$300	$75,000
Pavement Repairs	10,000	LF	$35	$350,000
Vac Station Site Preparation	1	LS	$50,000	$50,000
12" Force Main	16,740	LF	$60	$1,004,400
Maintenance of Traffic	1	LS	$30,000	$30,000
House Connection (Same Side)	246	LS	$1,500	$369,000
House Connection (Opp. Side)	246	LS	$3,000	$738,000
Business Connection (Same Side)	37	LS	$2,500	$92,000
Business Connection (Opp. Side)	37	LS	$5,000	$184,000
E-one grinder pump & house conn.	12	LS	$15,000	$180,000
Pressure connection & tie in	1	LS	$60,000	$60,000
Field Service Technician (Airvac) - full-time	1	LS	$150,000	$150,000
Flow Metering	1	LS	$50,000	$50,000
Mobilization	1	LS	3.00%	$243,315
Permits, Bonds, Fees	1	LS	5.00%	$405,526
Total				$8,759,356

Contingency	10.00%	$875,936
Interim financing	LS	$72,000
Start-up	LS	$10,000
Meetings	LS	$25,000
O&M Manual	LS	$40,000
Railroad Permits	LS	$120,000
Legal	LS	$25,000
Property/Easement Acquisition	LS	$100,000
Engineering	6.70%	$586,877
Construction Administration	1.00%	$87,594
Construction Inspection	2.50%	$218,984
Total Probable Construction Cost: Selected Alternative Cape Charles		$10,920,746

Appendix F

Rate Schedule
with
Intial Annual Operating Budget

C0NFIDENTIAL

Rate Schedule with Initial Operating Budget
Northampton County Southern Node Project
Alternate 1 - Cape Charles

Wastewater System - Alternate 1 Cape Charles Updated: Wednesday, July 14, 2010

Service Start: 7/1/2011

Operational Year #		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Fiscal Year		**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**
Residential Water Rate and Sales Information								
1	Minimum Monthly Residential Service Charge	$62.00	$63.86	$65.78	$67.75	$69.78	$71.87	$74.03
2	Average Monthly Commercial Service Charge	$100.00	$103.00	$106.09	$109.27	$112.55	$115.93	$119.41
3	Projected Total Initial Residential Connections (ERC)	492						
4	Projected New Residential Connections per year (ERC)	3	3	3	3	3	3	3
5	Total Residential Connections	495	498	501	504	507	510	513
6	Projected Total Initial Commercial Connections	74						
7	Projected New Commercial Connections per year (ERC)	1	1	1	1	1	1	1
8	Total Commercial Connections	75	76	77	78	79	80	81
9	Availability Charge = $2,500 (Res) for FY 12	$0	$2,500	$2,625	$2,756	$2,894	$3,039	$3,191
10	Availability Charge = $3,500 (Comm) for FY 12	$0	$3,500	$3,675	$3,859	$4,052	$4,254	$4,467
11	Connection Charge = $1,000 (Res) and (Comm)	$0	$1,000	$1,025	$1,051	$1,077	$1,104	$1,131
12	Inspection and Accounting Fee	$200	$200	$200	$200	$200	$200	$200
Annual Revenues								
13	Existing and New Residential Service Charges	$368,280	$381,627	$395,444	$409,746	$424,551	$439,875	$455,736
14	Existing and New Commercial Service Charges	$89,520	$93,442	$97,518	$101,755	$106,158	$110,734	$115,489
15	Availability Fee (New connections - Residential)	$0	$7,500	$7,875	$8,269	$8,682	$9,116	$9,572
16	Availability Fee (New connections - Commercial)	$0	$3,500	$3,675	$3,859	$4,052	$4,254	$4,467
17	Connection Fee (New connections - Residential)	$0	$3,000	$3,075	$3,152	$3,231	$3,311	$3,394
18	Connection Fee (New connections - Commercial)	$0	$1,000	$1,025	$1,051	$1,077	$1,104	$1,131
19	New Inspection & Account Fee (New connections)	$800	$800	$800	$800	$800	$800	$800
20	**TOTAL REVENUES**	$458,600	$490,869	$509,412	$528,631	$548,550	$569,195	$590,590
Annual Operation Expenses								
21	Total O & M New Collection System	$88,100	$89,865	$91,673	$93,525	$95,423	$97,368	$99,361
22	Total O&M Cape Charles Facilities (County share of O&M + Debt)	$176,000	$177,792	$179,620	$181,484	$183,386	$185,326	$187,304
23	**SUBTOTAL OPERATION EXPENSES**	$264,100	$267,657	$271,293	$275,010	$278,809	$282,693	$286,665
New Debt								
24	Level Debt Payment for New Collection System	$185,653	$185,653	$185,653	$185,653	$185,653	$185,653	$185,653
25	**SUBTOTAL NEW DEBT**	$185,653	$185,653	$185,653	$185,653	$185,653	$185,653	$185,653
26	**TOTAL EXPENSE**	$449,753	$453,310	$456,946	$460,662	$464,462	$468,346	$472,317
	Net Profit/Loss	**$8,847**	**$37,559**	**$52,467**	**$67,969**	**$84,089**	**$100,849**	**$118,272**
	Accumulated Cash Flow Balance	**$8,847**	**$46,407**	**$98,873**	**$166,842**	**$250,931**	**$351,779**	**$470,052**

Assumptions

1. Monthly Service Charge is a flat rate and increases at a rate of 3% per year starting in FY 11.
2. Availability and Connection fee is not charged for initial customer base (residential + commercial) for first year.
3. Availability Charge is $2,500 for Residential and $3,500 for Commercial in FY 12 and escalates at 5% per year
4. Connection Charge fee is $1,000 for Residential and Commercial in FY12 and escalates at 2.5% per year.
5. Inspection and Accounting fee remain constant through 2040.
6. Interest rate on the financed amount for the project = 0 %
7. Term of the amount financed = 30 years
8. Analysis assumes 50% forgivable loan
9. Total initial customer base is 80% of existing residential + commercial from Cheriton area customer base.xls

Wastewater System Updated: Wednesday, July 14, 2010

Service Start: 7/1/2011

Operational Year #	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Fiscal Year	**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**
Annual Revenue	$458,600	$490,869	$509,412	$528,631	$548,550	$569,195	$590,590
Annual Expenses	$449,753	$453,310	$456,946	$460,662	$464,462	$468,346	$472,317
Yearly Cashflow Reserve	$8,847	$37,559	$52,467	$67,969	$84,089	$100,849	$118,272
Percentage of Expenses	101.97%	108.29%	111.48%	114.75%	118.10%	121.53%	125.04%
Deficit to Make up (highlighted numbers)	$58,616	$30,437	$16,075	$1,130	($14,419)	($30,597)	($47,425)